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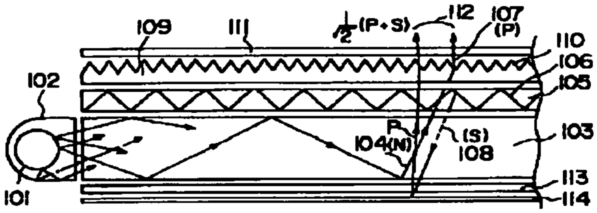
(54)【発明の名称】　表示装置

(57)【要約】

【目的】　光利用効率の向上を可能とする表示装置を提供することを目的とする。

【構成】　発光体と、直視型表示画面と、前記発光体からの光を直視型表示画面に導く導光体と、照明光を選択的に２つの偏光成分に分離し、所望の偏光成分を透過せしめ、不所望の偏光成分を反射する偏光分離素子と、反射された不所望の偏光成分を所望の偏光成分に変換し、偏光分離素子に戻す変換・反射部材とを具備することを特徴とする



【特許請求の範囲】

【請求項１】　発光体と、直視型表示画面と、前記発光体からの光を直視型表示画面に導く導光体と、照明光を選択的に２つの偏光成分に分離し、所望の偏光成分を透過せしめ、不所望の偏光成分を反射する偏光分離素子と、反射された不所望の偏光成分を所望の偏光成分に変換し、偏光分離素子に戻す変換・反射部材とを具備することを特徴とする表示装置。

【請求項２】　前記偏光分離素子は、前記導光体の表示装置側に配置されたシート状偏光ビームスプリッターであり、前記変換・反射部材は、前記導光体の表示装置側又は反対側に配置された偏光変換素子と、前記導光体の表示装置とは反対側に配置された反射板とを具備することを特徴とする請求項１に記載の表示装置。

【請求項３】　前記偏光分離素子は、前記発光体と前記導光体との間に配置された柱状偏光ビームスプリッターであり、前記変換・反射部材は、前記発光体と前記柱状偏光ビームスプリッターとの間に配置された偏光変換素子と、前記柱状偏光ビームスプリッターの光路と平行面に形成された反射鏡とを具備することを特徴とする請求項１に記載の表示装置。

【請求項４】　前記変換・反射部材は、前記導光体の前記表示装置とは反対側の面に形成された、入射側に傾斜面を有する凹凸面であり、前記凹凸面の入射側傾斜面は、入射光の入射角が下記の式で表されるブリュースター角又はその近傍となるような傾斜角度を有することを特徴とする請求項１に記載の表示装置。

$$\theta_B = \tan^{-1}(n_2 / n_1)$$

（式中、n_1 は入射側媒質屈折率、n_2 は出射側媒質屈折率である。）

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、平面直視型表示装置、特に液晶表示装置に関する。

【０００２】

【従来の技術】液晶表示装置は、薄型、軽量、低消費電力であるという特徴を有するため、広範な分野への利用がなされている。現在最も多く採用されている液晶表示装置の表示方式は、液晶を狭持したガラス基板の両側に偏光板を設け、液晶の配向状態を電気的に制御することで入射した光の偏光状態を変化させることにより光の透過、非透過すなわち明暗表示を行う方式である。液晶の表示方式は非発光型であるため、画面輝度を確保し、良好な画質を得るためには、照明装置を液晶表示パネル背面に備え、背後から照明する必要がある。

【０００３】かかる照明装置では、図１５に示すように、冷陰極管などの蛍光管発光体１０１からの白色光を、直接またはリフレクタ１０２により反射した後、導光板１０３に入射させる。導光板１０３内では光は全反射を生じ、ほとんど減衰することなく反射を繰り返すが、導光板１０３の下面には白色の印刷が施されており（図中省略）、光が印刷面に入射した場合、拡散反射効果により反射方向が変化して導光板１０３から照明方向に出射する。

【０００４】導光板１０３の上部には、画面表示領域への照度分布を均一化するための拡散板２０１、出射方向を適正な角度に制御するためのプリズムシート１０９、導光板１０３の下部には、白色の反射板１１４を備えていることが多い。このような照明装置を液晶パネルの下部に備えることで、明るくコントラストの高い液晶表示装置を実現している。

【０００５】

【発明が解決しようとする課題】ところが、発光体からの光は一般には非偏光であるため、従来の照明装置から出射した光は、液晶パネルの光入射側に設けられた偏光板を透過する際に、偏光板の透過軸に一致しない約半分の成分の光が吸収されてしまい、有効な照明光は照明装置から照射される光の１／２以下となり、光利用効率が低下するという問題があった。このため、十分に輝度の高い液晶表示装置を実現するためには、光源の発光量を増加させる必要があり、結果として消費電力の増大を招いていた。

【０００６】この問題を解決する一手法として、光源光を二つの直交する直線偏光に分割し、一方の偏光成分を所望する偏光成分に変換した後、偏光板に入射させる方法が提案されている（例えば特開平２－６４６１３号）。しかし、これら従来より提案されている手法は、偏光変換を行うために原理的に３次元的に広い空間が新たに必要となるため、投射型液晶表示装置など平面性をさほど必要としない液晶表示装置では可能であるが、直視型液晶表示装置においては液晶表示装置の薄型、軽量と言った特徴が失われてしまうという欠点があった。本発明は、かかる事情に鑑みなされ、直視型表示装置の薄型、軽量を維持しつつ、光利用効率の向上を可能とする表示装置を提供することを目的とする。

【０００７】

【課題を解決するための手段】上記課題を解決するため、本発明は、発光体と、直視型表示画面と、前記発光体からの光を直視型表示画面に導く導光体と、照明光を選択的に２つの偏光成分に分離し、所望の偏光成分を透過せしめ、不所望の偏光成分を反射する偏光分離素子と、反射された不所望の偏光成分を所望の偏光成分に変換し、偏光分離素子に戻す変換・反射部材とを具備することを特徴とする表示装置を提供する。

【０００８】より具体的には、本発明の表示装置は、表示画面、蛍光管などからなる発光体、均一な発光輝度を得るための導光体、表示画面の照明光として利用されない光を反射して再び有効な照明光とするために形成された反射面、境界面での反射、透過により偏光成分を分離するための偏光分離素子を具備する。偏光分離素子は、

光の入射角が斜めとなるような境界面に設けられた誘電体多層膜干渉面からなる偏光ビームスプリッター（以下ＰＢＳと略記）であるか、又は入射側傾斜面がブリュースター角に設定された境界面とすることが出来る。

【０００９】偏光分離素子の具体的構成としては、照明領域全面に多数並列配置された他部品とは別体からなる偏光ビームスプリッター、同様に照明部全面に設けられたプリズムシートのプリズム面に多層コートすることによってＰＢＳ作用を有するプリズムシート、発光体と導光体との間に設けられたＰＢＳ柱状体、発光体から導光体に光を入射させる際に光の入射角を制御するための導光制御体の斜面に多層コートすることによってＰＢＳ作用を有する導光制御体、及び照明光としての出射角度がブリュースター角度近傍となるような導光体のいずれかを採用することが出来る。あるいは、これらの手段の複数を兼ね備えたものとしてて構成することが出来る。

【００１０】偏光変換素子の材質としては、ガラスの他、プラスチックとしてポリカーボネート（PC）、ポリメチルメタクリレート（PMMA）、スチレンアクリロニトリル、ポリスチレン、メチルメタクリレート、シクロヘキシルメタクリレート、アリルジグライコールカーボネート、CR３９などが利用できる。

【００１１】偏光変換素子は、照明部全面もしくは発光体もしくはその両方に設けられた偏光分離素子と反射対の間に設けられた拡散体、もしくは複屈折位相差フィルムもしくはその組み合わせにより構成することが出来る。また、複屈折位相差フィルムは、光の入射角に対して１回透過の場合は１／２波長フィルム、反射を含む２回透過の場合は１／４波長フィルムとなるような特性を持つものを用いることが出来る。

【００１２】照明装置から照明光として出射された偏光光を、液晶パネルの入射側偏光板の透過軸方向に一致させて最大透過率を得られるような条件とするためには、１／２波長フィルムを入射側偏光板と光出射面の間に、その進相軸方向が出射偏光方向と偏光板透過軸の成す角度を１／２に分割するような方向として挿入するか、又は上記した照明部全面に設けられたＰＢＳシートを画面枠に対して斜め方向に設置して直接出射した偏光光が偏光板透過軸方向に一致するようにする。また、液晶パネルの入射側偏光板は必ずしも具備されていなくても良い。

【００１３】偏光変換素子として１／４波長フィルムを用いる場合、その進相軸を入射してくる偏光方向に対し４５°方向を成すようにして、直線偏光が円偏光に変換されるようにするのが望ましい。

【００１４】そのほか、本発明の表示装置を構成する光学部品のうち導光体は、透明平板状で平行平板型、くさび型どちらの形状をしていてもよく、導光板の下部には白色の印刷またはくさび状または球状の凹凸が照度分布を均一化するように配置されてもよい。反射体は、光沢性のある白色反射板またはＡｌなどの鏡面が望ましい。鏡面を用いる場合、表面に凹凸をつけて拡散反射性、もしくは特定方向に強い反射特性を持たせても良い。拡散板、プリズムシートは照明光の出射方向を均一化、もしくは集光化する目的で具備しても良いが、本発明の効果を得るために必ずしも必要不可欠ではない。

【００１５】

【作用】本発明の表示装置では、発光体から出射した光は導光体に入射し、反射屈折を繰り返した後、表示画面への照明光として出射する。この際、偏光分離素子により所望する偏光光のみが照明光として出射するが、不所望の偏光光は偏光分離素子により吸収されることなく導光体側に戻される。この偏光光は、拡散体による非偏光光化されるか、又は複屈折位相差フィルムにより所望の偏光成分に変換され、再び照明光として出射する。このため、従来、液晶パネルの入射側偏光板で吸収され、照明光として利用されなかった光成分が、照明光として有効に利用される。

【００１６】

【実施例】以下、本発明の種々の実施例を示し、本発明をより詳細に説明する。なお、以下の実施例では、液晶動作モードとして偏光板を利用するＴＮモードもしくはＳＴＮモードを用いた透過型液晶パネルを背面から照明する場合について説明する。

【００１７】図１は、本発明の第１の実施例に係る表示装置の構成を説明する、横向きから見た断面図である。図１に示す表示装置では、発光体として冷陰極蛍光管１０１、背面に光を反射するリフレクタ１０２が設けられており、蛍光管１０１から発せられた光は直接あるいはリフレクタ１０２で反射され、導光板１０３に入射する。この光１０４は、非偏光光（図中Ｎで表示）である。導光板１０３に入射した光１０４は、全反射を繰り返した後、導光板１０３から出射し、ＰＢＳシート１０５に入射する。

【００１８】ＰＢＳシート１０５は、シート面方向に対してほぼ４５°をなす境界面をなしており、その面に光学多層膜１０６が施されてている。この光学多層膜１０６に対し入射面内に含まれる偏光成分で定義される直線偏光光（図中Ｐ）１０７は、多層膜１０６との干渉効果により透過し、プリズムシート１０９の集光作用により集光される。一方、導光板１０３から出射する光のうち、直交する偏光成分光（図中Ｓ）１０８は、多層膜１０６との干渉効果により反射される。プリズムシート１０９にはプリズム面が溝状に形成されているが、このプリズム面１１０とＰＢＳシート１０５を透過した入射偏光光１０７の関係は、入射光がプリズム面に対しＰ波となるように形成されていることが望ましい。

【００１９】また、図１に示すように多層膜面方向と画面表示領域が平行となっている場合、プリズムシート１０９を出射した光１０７の偏光方向は、一般的に液晶パ

ネルの入射側偏光板（図中省略）の透過軸に一致していない。なぜなら、一般に液晶パネルの偏光板は視角を確保するため、図４（ａ）に示すように、偏光板の透過軸が表示領域の辺に対し４５°方向にとられるからである。このプリズムシート１０９を透過して集光された光は、第１の偏光変換素子である１／２波長フィルム１１１に入射する。１／２波長フィルム１１１の進相軸は、プリズムシート１０９を出射した偏光光の振動方向と液晶パネルの入射側偏光板の透過軸のなす角度の１／２の方向にほぼ一致している。１／２波長フィルム１１１は、入射した偏光光と進相軸のなす角度に対し偏光光と進相軸の方向に向かって２倍の角度回転させる作用を持つので、この配置により、プリズムシート１０９を出射した偏光光の振動方向は、液晶パネルの入射側偏光板の透過軸に一致することとなり、偏光板でほとんど吸収されることなく有効な照明光１１２として作用することとなる。ただし、偏光板の透過軸方向が画面表示領域の辺方向と平行な方向となっている場合などＰＢＳシート１０５を出射したＰ波の方向が一致している場合は、１／２波長フィルム１１１を省略できることはいうまでもない。

【００２０】一方、ＰＢＳシートの多層膜面１０６において反射されたＳ波１０８は、その偏光成分を変更することなく多層膜面１０６で２回反射することにより、その強度をほとんど減ずることなく入射してきた方向に再度導光板に入射する。導光板に入射した光は、その入射角度と導光板反射面のなす角度の関係によって再び全反射を繰り返すか、導光板１０３を透過する。全反射した光は、図中には示さないが、導光板１０３中で全反射を繰り返すうちに偏光度が減少し、蛍光管から出射した光と同様非偏光光となり、上記した作用によって再びＰＢＳシート１０５、プリズムシート１０９、１／２波長フィルム１１１を経た後、一部の光成分が有効な照明光１１２として利用される。

【００２１】導光板１０３を透過した光は、導光板１０３の下部に設けられた第２の偏光変換素子である１／４波長フィルム１１３に入射する。１／４波長フィルム１１３はＰＢＳシート１０５において反射されたＳ波１０８の振動方向に対し進相軸を４５°の方向に配置する。この配置によって、１／４波長フィルム１１３に入射した直線偏光は円偏光に変換されるが、１／４波長フィルムの更に下部に密着して設けられた反射板１１４により反射され、再度１／４波長フィルム１１３を透過する際に入射した偏光の振動方向に対し直交する成分となって出射することとなる。この偏光の振動方向は、ＰＢＳシート１０５への入射時において透過可能なＰ波に相当するため、有効な照明光１１２として液晶パネルに入射することとなる。

【００２２】このように、従来は液晶パネルの入射側偏光板によって吸収され照明光として利用されていなかった光成分を、本実施例の構成により入射側偏光板に吸収されることなく有効な照明光として利用することができるため、光利用効率の向上した明るい液晶パネル用照明装置を実現することができる。

【００２３】以上述べた本実施例において、偏光変換素子である１／２、１／４波長フィルムは、中心波長として可視域の任意の波長位置に設定できるが、望ましくは最も比視感度が高い緑の波長領域に設定されるのがよい。更に、これら位相差フィルムのうち１／２波長フィルム１１１は液晶パネルの入射側偏光板に、１／４波長フィルムは反射板１１４にそれぞれ密着して張り合わせられていることが望ましい。反射板１１４は反射率の高いＡｌ蒸着面など鏡面でも良く、ある程度拡散性を持たせるために光沢処理を施した白色板を用いても良い。

【００２４】また、モアレの発生を防ぐため、ＰＢＳシート、プリズムシートのピッチは、液晶パネルの画素配列周期に対しモアレを生じないように全く同一ピッチとするか、ピッチを細かくあるいは粗くして著しくピッチの異なる条件とするか、ピッチをランダム配列とするか、もしくはプリズムシートと液晶パネルの間に空隙を設けることが望ましい。更に、拡散透過効果をもつ拡散板を照明分布の適正化、モアレ発生の防止の目的でプリズムシート１０９の上面もしくはプリズムシート１０９とＰＢＳシート１０５の間もしくはプリズムシート１０５と導光板１０３の間もしくは導光板１０３と１／４波長フィルム１１３の間に一枚、あるいは複数枚、挿入箇所を組み合わせて挿入することも可能である。

【００２５】上述した表示装置のそれぞれの光学部品の光学的配置と光の振動方向との関係及びその作用を図２に示す。導光板１０３内で全反射を繰り返した光源光は非偏光光（図中Ｎ）であるため、互いに直交するＰ成分（図中Ｐと表示）とＳ成分（図中Ｓと表示）の両方の成分をほぼ等しく有している。この光がＰＢＳシート２０３に入射すると、Ｐ波は透過し、Ｓ波は反射される。透過したＰ波は１／２波長フィルム２０４を透過するが、波長フィルムの進相軸（図中Ｆと表示）がＰ方向に対して２２．５°方向となっているため、Ｐ波の回転角は進相軸方向に４５°（１／√２（Ｐ＋Ｓ）と表示）となる。この方向は液晶パネルの入射側偏光板２０５の透過軸（図中Ｔ）に一致しているため、ほとんど吸収されることなく透過し、すなわち照明光として利用される。

【００２６】一方、ＰＢＳシート２０３で反射されたＳ成分光は、導光板１０３の下部に設けられた１／４波長フィルム２０２に入射するが、１／４波長フィルム２０２の進相軸（図中Ｆと表示）はＳ方向に対して４５°の方向となっているため、透過光は円偏光（図中Ｃと表示）となる。この円偏光は反射板２０１での反射によってその回転方向が逆向きになるため、反射板２０１で反射されて再度１／４波長フィルム２０２を透過した際には、振動方向がＰ方向となる。従って、この光成分は、

直接ＰＢＳシート２０３に入射して透過するＰ波と同成分になるので、従来吸収されていたＳ偏光成分が照明光として有効に利用されることになる。

【００２７】図３は、本発明の第２の実施例に係る表示装置の構成を説明する図である。本実施例は、さきに説明した第１の実施例における構成のうち、反射板２０１の上部に設けられた第２の偏光変換素子である１／４波長フィルム２０２を取り除き、ＰＢＳシート１０９と導光板１０３の間に拡散シート３０１を挟み込んだ構造となっている。

【００２８】導光板１０３を出射した非偏光光（図中Ｎ）３０２は、拡散シート３０１により画面表示領域の照度分布が最適化されるよう適宜拡散された後、ＰＢＳシート１０５に入射する。ＰＢＳシートの多層膜面１０６を透過するＰ波成分については第１の実施例と同様、プリズムシート１０９による集光、１／２波長フィルム１１１による導光の回転をうけ、有効な照明光として液晶パネルに入射する。

【００２９】反射されたＳ波成分３０３は再度拡散シート３０１に入射するが、拡散シートで透過またはわずかに反射される際に拡散効果により非偏光光化（図中Ｎ、３０４）される。従って、ＰＢＳシート１０６によって反射されたＳ偏光成分３０３は、Ｐ波とＳ波の混合した非偏光３０４に変換されるため、導光板１０３の下部もしくは反射板１１４で反射され、再度ＰＢＳシート１０６に入射すると、入射光に含まれたＰ波成分３０５が選択的に透過され、照明光３０６として有効に利用されることになる。本実施例においても実施例１のように、位相差フィルムの条件、反射板の特性、ＰＢＳシート、プリズムシートのピッチ、拡散板の導入の有無など、各種の構成をとることが可能である。

【００３０】図４は、本発明の第３の実施例に係る表示装置の構成を説明する図である。第１の実施例で述べたように、液晶パネルの偏光板透過軸は、視角確保の要請から図４（ａ）に示すように、液晶表示領域の辺に対し４５°方向に配置されている。図中では入射側偏光板の透過軸を点線、出射側偏光板の透過軸を実線矢印で示した。このため、第１、第２の実施例においては、図４（ｂ）に示すように、ＰＢＳシートの多層膜面の形成方向１０６を画面表示領域の辺方向とした場合、１／２波長フィルムによって透過Ｐ偏光光を入射側偏光板の透過軸に一致するように４５°回転させている。

【００３１】これに対し、本実施例では、図４（ｃ）に示すように、ＰＢＳシートの多層膜面の形成方向１０６を画面表示領域の辺方向に対して４５°の方向に配置した。このような構造を取ることで、ＰＢＳシートを透過したＰ波は、１／２波長フィルムによって偏光変換を受けずとも偏光板の透過軸方向に一致するので、第１、第２の実施例における１／２波長フィルムを省略することが可能となり、それによってコストを低減することが出来る。また、偏光変換素子の波長分散によって生ずるホワイトバランスの劣化も無くなる。更に、ＰＢＳシートの方向は液晶パネルの画素配列方向に対しても４５°方向となるので、二つの周期構造配列の干渉効果によって生ずるモアレの発生は、視認されにくい高周波成分となり、表示画像劣化を抑制する効果も得られる。

【００３２】図５は、本発明の第４の実施例に係る表示装置の構成を説明する図である。本実施例では、プリズムシート１０９のプリズム境界面５０１に多層反射膜を施し、プリズムシート１０９に本来の機能である集光作用と第１、第２の実施例におけるＰＢＳシートのような偏光分離素子の機能とをあわせ持たせたことを特徴としている。

【００３３】導光板を出射した非偏光光５０２は、プリズムシート１０９に入射し、多層膜との干渉効果によりＰ波５０３は透過し、不所望のＳ波５０４は反射される。透過したＰ波５０３はプリズムの集光作用により最適な方向に照明光として出射され、更に１／２波長フィルム１１１によって所望する偏光方向に変換される。反射されたＳ波５０４は、多層膜面での２回の反射によって導光板１０３へ再入射する。以降、第１の実施例のように、１／４波長フィルム１１３、反射板１１４によりＰ偏光光５０５に変換され、プリズムシート１０９を透過して照明光として利用される。

【００３４】このように、本実施例によると、プリズムシートに偏光分離作用を持たせることで部品数を増加させることがなく、また表示装置の厚みを増加させることもなく、薄い表示装置を実現できる。なお、本実施例においても第２の実施例と組み合わせて１／４波長フィルム１１３を取り除き、拡散板２０１を付加することが可能なのは言うまでもない。

【００３５】図６は、本発明の第５の実施例に係る表示装置の構成を説明する図である。本実施例においては、蛍光管１０１から導光板１０３に入射する光路間にＰＢＳ柱状体６０１が配置されている。ＰＢＳ柱状体６０１の下面には反射鏡６０３がＡｌ蒸着などにより形成されており、光入射面である蛍光管側には１／４波長フィルム６０４が配置されている。液晶パネル照明領域の構成は、下から反射板１１４、導光板１０３、プリズムシート１０９、１／２波長フィルム１１１からなっている。

【００３６】蛍光管１０１から出射した非偏光光６０５は、１／４波長フィルム６０４を透過するが非偏光光であるため偏光変換作用は受けない。ＰＢＳ柱状体６０１に入射した光は、多層膜干渉面６０２においてＰ波６０６は透過し導光板１０３に入射するが、Ｓ波６０７は反射される。透過したＰ波６０６は、導光板１０３での全反射、プリズムシート１０９での集光、１／２波長フィルム１１１での偏光回転を受け、照明光として利用される。これらの部品内、部品間での反射はほぼ鏡面反射なので、Ｐ偏光光はその偏光度をほとんど減ずること無く

偏光光のまま有効に利用される。

【００３７】一方、反射されたＳ波６０７は、鏡面６０３により反射され、再度多層膜干渉面６０２で反射され、蛍光管側へ出射する。この際、１／４波長フィルム６０４を通過時にＳ成分の直線偏光から円偏光へ変換されるが、蛍光管１０１の管面、リフレクタ１０２により反射されて再び１／４波長フィルム６０４を透過する際にＰ波６０９に変換されるため、今度はＰＢＳ６０１を透過して導光板１０３に入射し、直接導光板に入射したＰ波６０６と同様照明光として利用されることとなる。従って、本実施例における構成で光利用効率を向上させることが可能である。

【００３８】また、本実施例と第１～４の実施例を組み合わせた構成をとることも可能である。この際、ＰＢＳ柱状体６０１から出射する偏光成分とＰＢＳシート、または偏光分離機能付きプリズムシートの透過光偏光成分が対応するような配置となるようにする必要があるのは言うまでもない。

【００３９】図７（ａ）は、本発明の第６の実施例に係る表示装置の構成を示した図である。本実施例における構成は、図６における第５の実施例の構成に加え、ＰＢＳ柱状体６０１と導光板１０３の間に１／２波長フィルム７０１を挟持したことを特徴としている。ＰＢＳ柱状体６０１を出射したＰ波６０９は、導光板１０３に入射する際に進相軸がＰ波６０９に対して４５°方向となった１／２波長フィルム７０１によってＳ波７０２に変換される。また、同様に図示はしないが進相軸をθ方向にとればＰ波とＳ波の両成分を含んだ２θ方向の直線偏光が、１／４波長フィルムを代わりに挿入すれば楕円偏光または円偏光が得られる。

【００４０】このように、ＰＢＳ柱状体６０１と導光板１０３との間に偏光変換素子である１／２波長フィルムもしくは１／４波長フィルムを挿入することで、任意の偏光成分をもった光を導光板内に入射させることができ、プリズムシート１０９に入射する光の偏光状態を自由に設計、最適化することができる。

【００４１】また、本実施例は、図７（ｂ）に示すように、画面表示領域の長辺方向、短辺方向のそれぞれに蛍光管を設けた場合、またはＬ字型蛍光管を使用した場合は、導光板に入射させる偏光方向を互いに直交させなくてはならないので、一方をＰＢＳ柱状体６０１を出射後に偏光変換可能な本実施例、他方を本実施例もしくは図６における第５の実施例とする必要がある。

【００４２】図８は、本発明の第７の実施例に係る表示装置の構成を示した図である。この実施例は、図６に示す第５の実施例に対し、ＰＢＳ６０１とリフレクタ１０２間にある１／４波長フィルム６０４の位置を蛍光管１０１、リフレクタ１０２の表面に変更したことを特徴とする。このような配置をとることで、第５の実施例と同一の効果が得られるだけでなく、１／４波長フィルム６０４が反射面に密着しているために、光が入射、反射時の２回、１／４波長フィルム６０４内を通る際、透過領域はほぼ同じ部分となる。従って、１／４波長フィルム６０４の特性を各部位毎に最適化することで偏光変換効率を向上させることが可能である。

【００４３】図９は、本発明の第８の実施例に係る表示装置の構成を示した図である。本実施例においては図６における第５の実施例と比較してＰＢＳ６０１の多層膜干渉面６０２を図に示すように２面設けた。この構成とすることで、第５の実施例と比較した場合反射されて蛍光管側に再入射するＳ波６０７の反射回数を１回減らすことができ、反射時の光強度の減少を抑えることが可能となる。

【００４４】図１０（ａ）、（ｂ）は本発明の第９の実施例に係る表示装置の構成を示す図である。本実施例においては、蛍光管１０１から導光板１０３に入射する光路間に、導光板１０３に入射する光の入射角度分布を適正に制御する導光制御体１００１が配置されている。この導光制御体１００１は、光出射面１００３に偏光分離機能を有する多層膜干渉面、上下部に鏡面１００４を具備している。

【００４５】図１０（ａ）は凸型の導光制御体、図１０（ｂ）は凹型の導光制御体を使用した実施例である。導光制御体１００１は、図１１（ａ）、（ｂ）に示すように、光源からの光を導光板１０３に入射する際の入射角度分布１００２を全反射の生じる適正な角度分布に制御する機能を有する。入射角度分布は、導光制御体１００１の屈折率と光出射面１００３の角度により決定される。

【００４６】本実施例では、光出射面１００３に多層膜干渉面を設けることで、反射されたＳ波６０７は反射鏡面１００４で反射した後、実施例５と同様に１／４波長フィルム６０４の２回透過によりＰ波６０６に変換され導光板に入射する。ここで、多層膜干渉面は、本来の導光制御体の機能である光出射方向の制御については寄与しないため、一つの導光制御体に導光制御機能と偏光分離機能を合わせ持たせることが可能である。

【００４７】このように、本実施例の構成をとることで、導光制御機能と偏光変換機能を従来の構成に比べ部材や装置の増大化を招くことなく有することが可能となる。また、本実施例において、１／４波長フィルム６０４の位置を図１０（ａ）、（ｂ）の位置から反射面１００４の間に挿入しても同様の効果を得ることができる。この場合、多層膜干渉面１００３から反射面１００４に入射する光は斜入射となるのでこれら斜入射成分光に対して１／４波長フィルムとなるようにリタデーションを最適化する必要がある。

【００４８】図１２（ａ）、（ｂ）は、本発明の第１０の実施例に係る表示装置の構成を説明する図である。本実施例では、光入射側に斜入射面を設けて導光板への入

射角を制御する方式の導光制御体１００１に偏光分離機能を持たせたことを特徴としている。本実施例では、斜入射面１００３に光源側から１／４波長フィルム６０４、保護層、多層膜干渉面を順次形成した。

【００４９】この構成における作用とその効果は第９の実施例と同様であるが、偏光分離機能を持つ多層膜干渉面と偏光変換機能を持つ１／４波長フィルムが殆ど接しているため、反射されたＳ波を効率よく円偏光化することが可能となる。また、１／４波長フィルム６０４と蛍光管１０１、リフレクタ１０２で反射する距離を近くすることができるので、反射による光強度の減少を抑えることができる。

【００５０】以上述べた本発明の第６～第１０の実施例の構成についても、第５の実施例と同様第１～第４の実施例と組み合わせて使用することが可能である。図１３は本発明の第１１の実施例に係る表示装置の構成を説明する図である。本実施例の特徴は、導光板１０３の下部に、断面鋸刃状の凹部１２０１を設けたことを特徴としている。本実施例における偏光分離の原理は、ブリュースター角$\theta_B = \tan^{-1}(n_2／n_1)$（$n_1$：入射側媒質屈折率、$n_2$：出射側媒質屈折率）で表される角度での境界面での屈折、反射を利用したものである。

【００５１】蛍光管１０１を出射した光１２０２は非偏光光であり、導光板１０３に入射し全反射を繰り返す。この光が導光板１２０２の下部に設けられた凹部１２０１に入射すると、境界面への入射角が全反射領域から外れるため、導光板１０３から出射してプリズムシート１０９により適正な角度に出射角度を制御された後、１／２波長フィルム１１１を透過し、照明光となる。このとき、凹部の角度と光の入射角の関係を適正に制御することで偏光分離を行うことができる。以下、この部分について詳述する。

【００５２】図１４は、図１３における導光体１０３と下部に設けられた凹部１２０１を拡大して示した図である。非偏光光１３０１が導光板底面に対しαの角度で入射する場合を考える。このとき、凹部の光反射境界面１３０６に対する入射角度がθＢを成していれば、Ｓ波成分のうち約１５％が反射されるが、Ｐ波成分はほぼすべて透過する。反射されたＳ波１３０２は、導光板１０３の上部境界面に対する入射角度が全反射とならない角度条件となるので、導光板を出射し、偏光照明光として利用される。

【００５３】一方、光反射境界面１３０６を透過する約８５％のＳ波成分とＰ波成分のすべて１３０３は、一旦導光板を出射するが、直接または反射板１１４で反射した後境界面１３０７に再入射し、隣接する凹部の光反射境界面で偏光選択反射を受けるか、導光板底面または上面で全反射を繰り返すこととなる。全反射となる場合は、偏光方向に対し斜め反射を繰り返すことでＰ波成分からＳ波成分への変換が適宜生じる。また、反射による偏光の変換が十分に行われない場合は、境界面１３０７にλ／２フィルムを設けて偏光を回転させるか、弱い拡散面として非偏光光化しても良い。このように、導光板底面に最適な角度成分の凹部を設けることで、偏光度の高い照明光を効率よく取り出すことが可能となる。

【００５４】導光板材料としてポリメチルメタクリレート（ＰＭＭＡ）を利用した場合、屈折率は約１．５であるので、光出射側を空気（屈折率１．０）とすると、全反射を繰り返す光１３０１の入射角度αの範囲は０°＜α＜４８．２°である。従って、この範囲にある光の一成分が境界面１３０６とブリュースター角θＢの関係を成すためには、凹部の境界面１３０６と導光板下部平面部の成す角度θを１４．３°＜θ＜５６．３°、望ましくは２６．３°＜θ＜３６．３°の領域に設定すれば良い。

【００５５】また、ポリカーボネート（ＰＣ）を導光板材料として選択した場合は、屈折率が約１．６となるので、０°＜α＜５１．３°の条件から、１６．０°＜θ＜５８．０°、望ましくは２８．０°＜θ＜３８．０°とするのが良い。光出射面を含む凹部をこの角度範囲に選び、凹部のへこみの高さを最適化することで、照明領域全面にわたって均一な照度、偏光度を持つ照明光を得ることが可能である。

【００５６】なお、本実施例は、第１～４の実施例のいずれか、若しくは第５～１０の実施例のいずれかと組み合わせて、又は第１～４の実施例のいずれか及び第５～１０の実施例のいずれかを適宜組み合わせて適用することが可能である。

【００５７】

【発明の効果】以上説明したように、本発明によれば、発光体から出射した光のうち所望する偏光光を照明光として出射させるとともに、不所望の偏光光は偏光分離素子により吸収されることなく導光体側に戻され、非偏光光化されるか、又は所望の偏光成分に変換されて、再び偏光分離素子に入射される。このため、従来、液晶パネルの入射側偏光板で吸収され、照明光として利用されなかった光成分が、照明光として有効に利用され、従って、偏光光を利用する平面型液晶表示装置として従来よりも光利用効率の高い表示装置を実現することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施例に係る表示装置の構成を説明する図。

【図２】本発明の第１の実施例の原理を説明する図。

【図３】本発明の第２の実施例に係る表示装置の構成を説明する図。

【図４】液晶パネルの偏光板の透過軸、及び第１、第２及び第３の実施例を説明する図。

【図５】本発明の第４の実施例に係る表示装置の構成を説明する図。

【図６】本発明の第５の実施例に係る表示装置の構成を説明する図。

【図７】本発明の第６の実施例に係る表示装置の構成を説明する図。

【図８】本発明の第７の実施例に係る表示装置の構成を説明する図。

【図９】本発明の第８の実施例に係る表示装置の構成を説明する図。

【図１０】本発明の第９の実施例に係る表示装置の構成を説明する図。

【図１１】本発明の第９の実施例に係る表示装置の作用を説明する図。

【図１２】本発明の第１０の実施例に係る表示装置の構成を説明する図。

【図１３】本発明の第１１の実施例に係る表示装置の構成を説明する図。

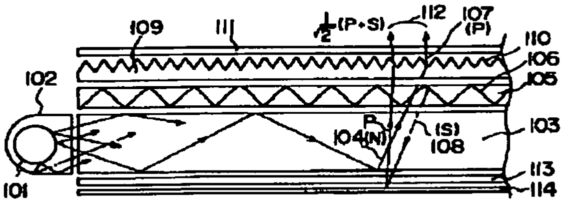
【図１４】本発明の第１１の実施例に係る表示装置の原理を説明する図。

【図１５】従来の表示装置の構成を説明する図。

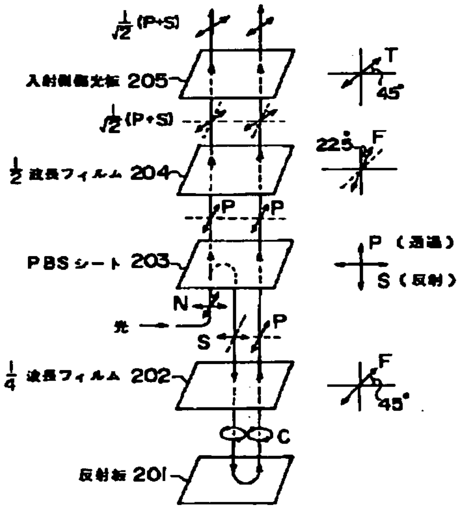
【符号の説明】

１０１…蛍光管、１０２…リフレクタ、１０３…導光板、１２０１…凸部、１４０１…凹部、１０５，２０３、…ＰＢＳシート、１０６，６０２…多層膜、１０９…プリズムシート、１１０，５０１、…プリズム面、１１１，２０４，７０１…１／２波長フィルム、１１３，２０２，６０４…１／４波長フィルム、１１４，２０１…反射板、２０５…入射側偏光板、３０１…拡散シート、６０１…ＰＢＳ、６０３，１００４…反射鏡、１００１…導光制御体、１００３，１３０６，１３０７…光出射面、１０４，３０２，３０４，５０２，６０５，１２０２，１３０１…非偏光光、１０７，３０５，５０３，５０５，６０６，６０９…偏光光（Ｐ波）、１０８，３０３，５０４，６０７，７０２…偏光光（Ｓ波）、１１２，３０６，１３０２…照明光、１３０３…部分偏光

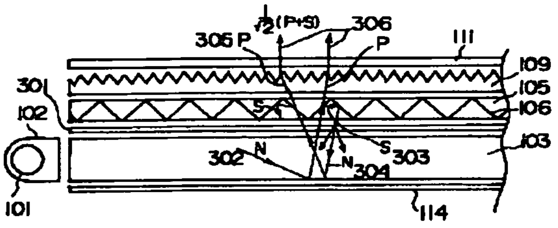
【図１】



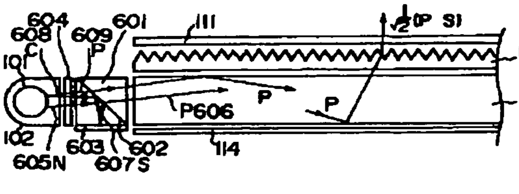
【図２】


$\frac{1}{\sqrt{2}}$(P+S)
入射側偏光板 205
T
45°
$\frac{1}{\sqrt{2}}$(P+S)
22.5°
F
$\frac{1}{2}$ 波長フィルム 204
P
P
PBSシート 203
P（透過）
S（反射）
N
光
P
S
$\frac{1}{4}$ 波長フィルム 202
F
45°
C
反射板 201

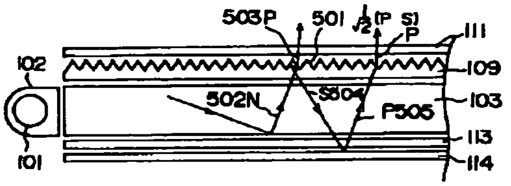
【図３】



【図６】



【図５】



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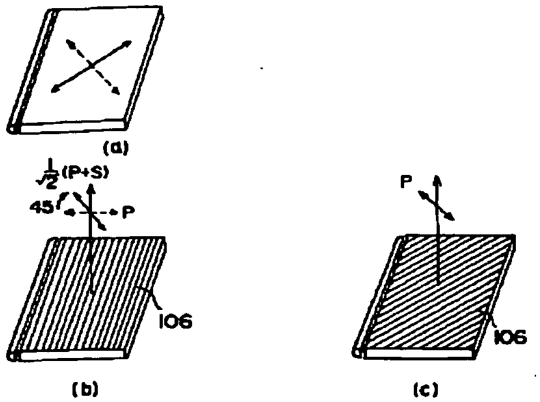

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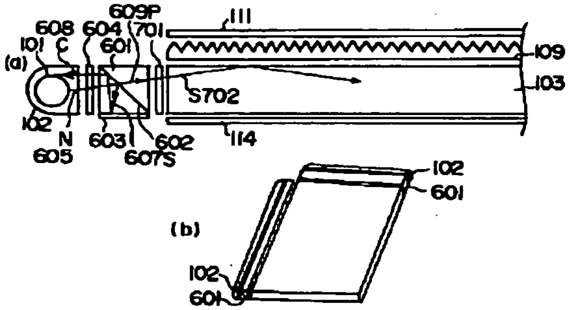

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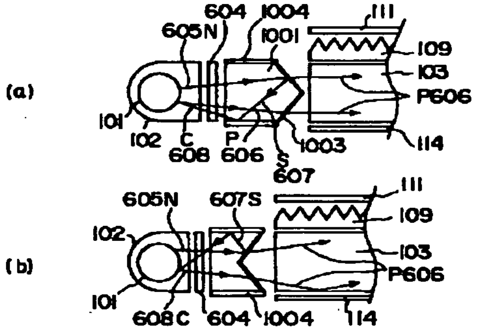
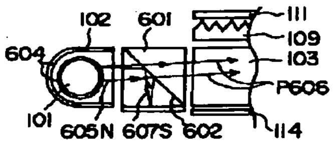
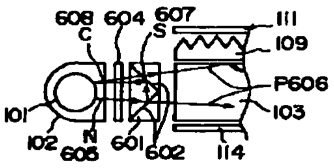


【図8】



【図9】



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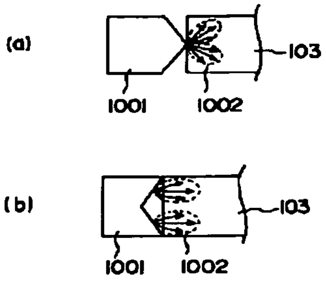

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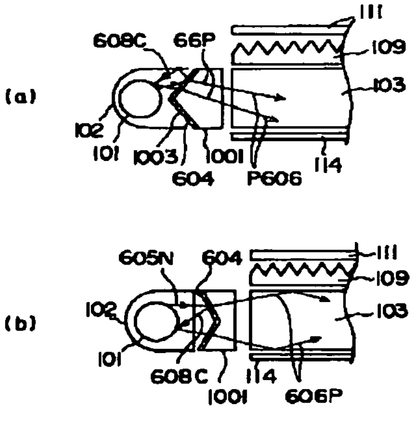
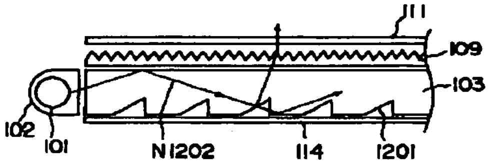


【図13】



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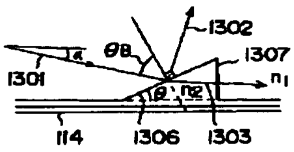
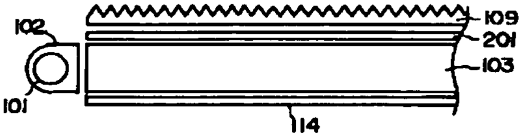


【図15】



【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第６部門第２区分
【発行日】平成１３年1月２６日（２００１．１．２６）

【公開番号】特開平８－８７０１１
【公開日】平成８年４月２日（１９９６．４．２）
【年通号数】公開特許公報８－８７１
【出願番号】特願平６－２２２１９２
【国際特許分類第７版】
G02F 1/1335 530
510
F21V 8/00
G02B 6/00 331
27/28
【ＦＩ】
G02F 1/1335 530
510
F21V 8/00 D
G02B 6/00 331
27/28 Z

【手続補正書】
【提出日】平成１１年7月５日（１９９９．７．５）
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】発光体と、
表示画面と、
前記発光体からの光の内、第１直線偏光成分を透過し、第２直線偏光成分を反射する偏光分離素子と、
前記偏光分離素子で反射された第２直線偏光成分を反射し、前記偏光分離素子に戻す反射部材とを具備することを特徴とする表示装置。
【請求項２】　前記反射部材は、前記第２直線偏光成分を前記第１直線偏光成分に変換することを特徴とする請求項１記載の表示装置。
【請求項３】　前記表示画面が液晶パネルであることを特徴とする請求項１記載の表示装置。
【請求項４】　前記表示画面と前記偏光分離素子との間に偏光変換素子を具備することを特徴とする請求項１記載の表示装置。
【請求項５】発光体と、
表示画面と、
前記発光体からの光の内、第１偏光成分を透過し、第２偏光成分を反射する偏光分離素子と、
前記表示画面に対向配置され、前記発光体からの光の入射側に傾斜面を有する凹凸面を有する反射部材とを具備し、
前記傾斜面は、発光体からの光の入射角がブリュースター角近傍である傾斜角度を成すことを特徴とする表示装置。

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-087011
(43)Date of publication of application : 02.04.1996

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(51)Int.Cl.	G02F 1/1335 G02F 1/1335 F21V 8/00 G02B 6/00 G02B 27/28

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(21)Application number :	06-222192	(71)Applicant :	TOSHIBA CORP
(22)Date of filing :	16.09.1994	(72)Inventor :	TAIRA KAZUKI HIGUCHI YOSHINORI

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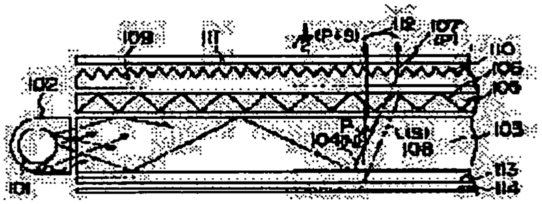
(54) DISPLAY DEVICE

(57)Abstract:

PURPOSE: To improve light utilization efficiency while the device is made thin and light by providing a converting and reflecting member which converts a reflected undesired polarized component to a desired polarized component and returns it to a polarizing and separating element.

CONSTITUTION: Orthogonal polarized component light (S) 108, out of light emitted from a light transmission plate 103, is reflected by an interference effect with a multilayer film 106. The light made incident on the light transmission plate 103 again repeats total reflection again or is transmitted through the light transmission plate 103. The light transmitted through the light transmission plate 103 is made incident on a 1/4 wavelength film 113 and the linearly polarized light is converted to the circularly polarized light and reflected by a reflector 114 and emitted after it becomes the component orthogonal to the oscillating direction of the polarized light made incident when it is transmitted through the film 113 again. Since the oscillating direction of the polarized light is equivalent to P wave which can be transmitted when the light is made incident on a PBS (polarizing beam splitter) sheet 105, the light is made incident on a liquid crystal panel as effective illuminating light 112.



LEGAL STATUS

[Date of request for examination]	05.07.1999
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	

[Patent number]	3219943
[Date of registration]	10.08.2001
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-087011
(43)Date of publication of application : 02.04.1996

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1)Int.CI.
G02F 1/1335
G02F 1/1335
F21V 8/00
G02B 6/00
G02B 27/28

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1)Application number : 06-222192
2)Date of filing : 16.09.1994

(71)Applicant : TOSHIBA CORP
(72)Inventor : TAIRA KAZUKI
HIGUCHI YOSHINORI

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4) DISPLAY DEVICE

7)Abstract:
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›nverts a reflected undesired polarized component to a desired polarized
›mponent and returns it to a polarizing and separating element.
ONSTITUTION: Orthogonal polarized component light (S) 108, out of
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terference effect with a multilayer film 106. The light made incident on
ıe light transmission plate 103 again repeats total reflection again or is
ansmitted through the light transmission plate 103. The light transmitted
ırough the light transmission plate 103 is made incident on a 1/4
avelength film 113 and the linearly polarized light is converted to the
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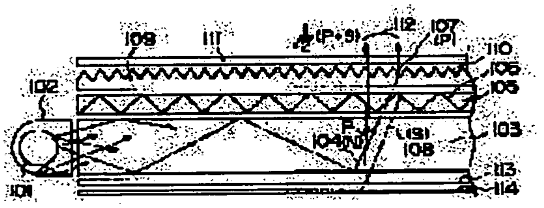
becomes the component orthogonal to the oscillating direction of the
›larized light made incident when it is transmitted through the film 113
;ain. Since the oscillating direction of the polarized light is equivalent to
wave which can be transmitted when the light is made incident on a
3S (polarizing beam splitter) sheet 105, the light is made incident on a
ıuid crystal panel as effective illuminating light 112.



:GAL STATUS
›ate of request for examination] 05.07.1999
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AIMS

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laim(s)]
laim 1] Display characterized by providing the following. Emitter. Direct-viewing-type display screen. The nsparent material which leads the light from the aforementioned emitter to the direct-viewing-type display screen. conversion and reflection which divides lighting light into two polarization components alternatively, is made to netrate a desired polarization component, changes into the polarization component of a request of the polarization aration element which reflects a non-wanted polarization component, and the reflected non-wanted polarization nponent, and is returned to a polarization separation element -- a member
laim 2] It is the display according to claim 1 characterized by for the aforementioned polarization separation element ng a sheet-like polarization beam splitter arranged at the display side of the aforementioned transparent material, 1 the aforementioned conversion / reflective member possessing the reflecting plate by which the polarization sing element arranged at the display side of the aforementioned transparent material or the opposite side and the play of the aforementioned transparent material have been arranged at the opposite side.
laim 3] It is the display according to claim 1 characterized by providing the reflecting mirror which the rementioned polarization separation element is a pillar-shaped polarization beam splitter arranged between the rementioned emitter and the aforementioned transparent material, and was formed in the polarization sensing ment by which the aforementioned conversion / reflective member has been arranged between the aforementioned itter and the aforementioned pillar-shaped polarization beam splitter, the optical path of the aforementioned pillar-aped polarization beam splitter, and the parallel side.
laim 4] For the aforementioned display of the aforementioned transparent material, the aforementioned conversion / lective member is display according to claim 1 characterized by having the degree of tilt angle from which it comes the brewster's angle expressed with the formula of the following [are the concavo-convex field which was med in the field of an opposite side, and which has an inclined plane in an incidence side, and / slant face / incidence eroversion / of the aforementioned concavo-convex field / incident angle / of an incident light], or its near.
taB =tan-1 (n2 / n1)
s for n1, an incidence side medium refractive index and n2 are outgoing radiation side medium refractive indexes ong a formula.)

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ETAILED DESCRIPTION

›etailed Description of the Invention]
001]
ıdustrial Application] this invention relates to flat-surface direct-viewing-type display, especially a liquid crystal splay.
002]
›escription of the Prior Art] Since it has the feature that liquid crystal displays are a thin shape, lightweight, and a low ›wer, use in an extensive field is made. The means of displaying of the liquid crystal display adopted is a method hich performs transparency of light, and nontransparent, i.e., a light-and-darkness display, by changing the ›larization state of the light which carried out incidence by preparing a polarizing plate in the both sides of the glass .bstrate which ****(ed) liquid crystal, and controlling the orientation state of liquid crystal electrically. [present ost] In order to secure screen intensity since it is the un-emitting type of light, and to obtain good quality of image, e means of displaying of liquid crystal needs to equip a liquid crystal display back-with-raised-bands side with a ghting system, and needs to illuminate it from behind.
003] In this lighting system, as shown in drawing 15 , after reflecting the white light from the fluorescence pipe nitters 101, such as a cold cathode tube, by direct or the reflector 102, incidence is carried out to a light guide plate)3. Although reflection is repeated within a light guide plate 103, without light's producing total reflection and :creasing almost, it is spread, when white printing is given to the inferior surface of tongue of a light guide plate 103 llipsis among drawing) and light carries out incidence to a printing side.
004] The prism sheet 109 for controlling the diffusion board 201 for equalizing the illumination distribution to a reen-display field and the direction of outgoing radiation at a proper angle and the lower part of a light guide plate)3 are equipped with the white reflecting plate 114 in many cases at the upper part of a light guide plate 103. By uipping the lower part of a liquid crystal panel with such a lighting system, the bright high liquid crystal display of ›ntrast is realized.
005]
roblem(s) to be Solved by the Invention] However, when the light which carried out outgoing radiation from the ›nventional lighting system since the light from an emitter was generally a unpolarized light penetrated the polarizing ate prepared in the optical incidence side of a liquid crystal panel, the light of the component of the abbreviation half hich is not in agreement with the transparency shaft of a polarizing plate will be absorbed, and an effective lighting ght became 1/2 or less [of the light irradiated from a lighting system], and had the problem that efficiency for light ilization fell. For this reason, in order to realize a liquid crystal display with fully high brightness, the amount of minescence of the light source needed to be made to increase, and increase of power consumption was caused as a sult.
006] As a way method which solves this problem, light source light is divided into the two linearly polarized lights hich intersect perpendicularly, and after changing into the polarization component which asks for one polarization ›mponent, the method of carrying out incidence to a polarizing plate is proposed (for example, JP,2-64613,A). owever, theoretically [in order to perform polarization conversion], since [three dimensions] latus space was newly :eded-like, although the technique proposed from these former was possible, it had the fault that the thin shape of a]uid crystal display and the feature referred to as lightweight will be lost in a direct-viewing-type liquid crystal splay, with the liquid crystal display which does not need smoothness, such as a projected type liquid crystal display, › much. It aims at offering the display which enables improvement in efficiency for light utilization, this invention :ing made in view of this situation, and maintaining the thin shape of direct-viewing-type display, and ****.
'007]
/leans for Solving the Problem] In order to solve the above-mentioned technical problem, this invention An emitter

d the direct-viewing-type display screen, The transparent material which leads the light from the aforementioned ıitter to the direct-viewing-type display screen, and the polarization separation element which divides lighting light :o two polarization components alternatively, is made to penetrate a desired polarization component, and reflects a ·n-wanted polarization component, It changes into the polarization component of a request of the reflected non-ınted polarization component, and the display characterized by providing conversion / reflective member returned to ɔolarization separation element is offered.

008] More specifically, the display of this invention possesses the polarization separation element for reflection in ɜ reflector and interface which were formed in order to reflect the light which is not used as the transparent material r obtaining the emitter and the uniform luminescence brightness which consist of the display screen, a fluorescence ɔe, etc., and a lighting light of the display screen and to consider as an again effective lighting light, and transparency parating a polarization component. Let a polarization separation element be the interface where it is the polarization am splitter (Following PBS and brief sketch) which consists of a dielectric multilayer interference side established in . interface where the incident angle of light becomes slanting, or the incidence side inclined plane was set as the ewster's angle.

009] The polarization beam splitter which the parallel arrangement of a large number was carried out all over the ;hting field, and also serves as parts from another object as concrete composition of a polarization separation ɜment, The prism sheet which has a PBS operation by carrying out a multilayer coat to the prism side of a prism eet similarly established all over the lighting section, The light guide control object which has a PBS operation by rrying out a multilayer coat to the slant face of the light guide control object for controlling the incident angle of light case incidence of the light is carried out to a transparent material from the PBS pillar-shaped object established ·tween the emitter and the transparent material, and an emitter, And either of the transparent materials which the ıtgoing radiation angle as a lighting light consists of near the degree of brewster's angle is employable. Or the urality of these meanses can be had and constituted.

010] Glass etc. can be used as the quality of the material of a polarization sensing element, and a polycarbonate (PC), ɔolymethylmethacrylate (PMMA), styrene acrylonitrile, polystyrene, methyl methacrylate, cyclohexyl methacrylate, ˌyl-compound JIGURA equal carbonate, CR39, etc. can be used as plastics.

011] The polarization separation element prepared in the whole lighting section surface, an emitter, or its both, the ffuser prepared between reflective pairs, a birefringence phase contrast film, or its combination can constitute a ·larization sensing element. Moreover, in the 2 times transparency in which a birefringence phase contrast film cludes a 1/2-wave film and reflection to the incident angle of light in 1-time transparency, a thing with a property ıich serves as a 1/4-wave film can be used.

012] In order to consider as the conditions which the polarization light by which outgoing radiation was carried out a lighting light from the lighting system is made in agreement with the transparency shaft orientations of the cidence side polarizing plate of a liquid crystal panel, and can obtain the maximum permeability [whether it inserts a direction which divides into one half the angle to which the outgoing radiation polarization direction and a ·larizing plate transparency shaft accomplish / the phase leading shaft orientations / a 1/2 wave film between an cidence side polarizing plate and an optical outgoing radiation side, and] Or it is made in agreement [the ·larization light which installed the PBS sheet prepared all over the above-mentioned lighting section in the direction 'slant to the screen frame, and carried out outgoing radiation directly] with polarizing plate transparency shaft ientations. Moreover, it is not necessary to necessarily provide the incidence side polarizing plate of a liquid crystal ınel.

013] When using a 1/4-wave film as a polarization sensing element, it is desirable to change the linearly polarized ;ht into the circular polarization of light, as the direction of 45 degree is accomplished to the polarization direction hich carries out incidence of the phase leading shaft.

014] in addition, the inside of the optic which constitutes the display of this invention -- a transparent material -- ınsparent plate-like -- an parallel monotonous type and a wedge type -- which configuration may be carried out, and may be arranged at the lower part of a light guide plate so that white printing or the shape of a wedge, and spherical :egularity may equalize an illumination distribution Mirror planes of a reflector, such as a glossy white reflecting ate or aluminum, are desirable. When using a mirror plane, irregularity may be given to a front face and diffuse flection nature or a reflection property strong against the specific direction may be given. A diffusion board and a ism sheet are a book although the direction of outgoing radiation of lighting light may be provided for equalization or e condensing-ized purpose.

015]

'unction] In the display of this invention, after it carries out incidence of the light which carried out outgoing diation from the emitter to a transparent material and it repeats reflective refraction, outgoing radiation of it is carried it as a lighting light to the display screen. Under the present circumstances, although only the polarization light for ich it asks by the polarization separation element carries out outgoing radiation as a lighting light, a non-wanted larization light is returned to a transparent material side, without being absorbed by the polarization separation ement. This polarization light is based on a diffuser, and is formed into unpolarized-light light, or is changed into a sired polarization component by the birefringence phase contrast film, and carries out outgoing radiation as a hting light again. For this reason, conventionally, it is absorbed with the incidence side polarizing plate of a liquid ystal panel, and the optical component which was not used as a lighting light is effectively used as a lighting light.

016]

xample] Hereafter, the various examples of this invention are shown and this invention is explained more to a detail. addition, the following examples explain the case where the penetrated type liquid crystal panel using TN mode or N mode which a polarizing plate is used as a liquid crystal mode of operation is illuminated from a tooth back.

017] Drawing 1 is the cross section explaining the composition of the display concerning the 1st example of this vention seen from sideways. In the display shown in drawing 1 , the reflector 102 which reflects light is formed in e cold cathode fluorescence pipe 101 and the tooth back as an emitter, it is reflected by direct or the reflector 102, d incidence of the light emitted from the fluorescence pipe 101 is carried out to a light guide plate 103. This light 4 is unpolarized-light light (it displays all over [N] drawing). After the light 104 which carried out incidence to the ht guide plate 103 repeats total reflection, outgoing radiation of it is carried out from a light guide plate 103, and it rries out incidence to the PBS sheet 105.

018] The PBS sheet 105 is making the interface which makes about 45 degrees to the direction of a sheet side, and e optical multilayer 106 is given to the field. The linearly polarized light light (inside P of drawing) 107 defined by e polarization component contained in plane of incidence to this optical multilayer 106 is penetrated according to the terference effect with a multilayer 106, and is condensed by condensing operation of the prism sheet 109. The larization component light (inside S of drawing) 108 which intersects perpendicularly on the other hand among the ht which carries out outgoing radiation from a light guide plate 103 is reflected according to the interference effect th a multilayer 106. Although the prism side is formed in the prism sheet 109 in the shape of a slot, as for the lation of the incidence polarization light 107 which penetrated this prism side 110 and the PBS sheet 105, it is sirable to be formed so that an incident light may serve as a primary wave to a prism side.

019] Moreover, as shown in drawing 1 , when the direction of a multilayer side and a screen-display field are rallel, generally the polarization direction of the light 107 which carried out outgoing radiation of the prism sheet 9 is not in agreement with the transparency shaft of the incidence side polarizing plate (ellipsis among drawing) of a uid crystal panel. Generally the polarizing plate of a liquid crystal panel is because the transparency shaft of a larizing plate is taken in the direction of 45 degree to the side of a viewing area as shown in drawing 4 (a), in order secure a viewing angle. Incidence of the light condensed by penetrating this prism sheet 109 is carried out to the 1/2-ive film 111 which is the 1st polarization sensing element. The phase leading shaft of the 1/2-wave film 111 is rrying out simultaneously coincidence of the prism sheet 109 in the oscillating direction of the polarization light ich carried out outgoing radiation, and the direction of one half of the angles which the transparency shaft of the cidence side polarizing plate of a liquid crystal panel makes. Since the 1/2-wave film 111 has the operation of double ecision which carries out angle rotation toward polarization light and phase leading shaft orientation to the angle ich the polarization light which carried out incidence, and a phase leading shaft make The oscillating direction of e polarization light which carried out outgoing radiation of the prism sheet 109 will be in agreement with the insparency shaft of the incidence side polarizing plate of a liquid crystal panel with this arrangement, and it will act an effective lighting light 112, without absorbing almost with a polarizing plate. However, when P direction waves ich carried out outgoing radiation of the PBS sheet 105 when the transparency shaft orientations of a polarizing ate had turned into the direction of the side of a screen-display field and an parallel direction are in agreement, it nnot be overemphasized that the 1/2-wave film 111 is omissible.

020] On the other hand, incidence of S wave 108 reflected in the multilayer side 106 of a PBS sheet is again carried it to a light guide plate in the direction which has carried out incidence by reflecting twice in respect of [106] a ultilayer, without changing the polarization component, without reducing most of the intensity. The light which rried out incidence to the light guide plate repeats total reflection again by the relation of the degree of incident angle d angle which a light guide plate reflector makes, or penetrates a light guide plate 103. After passing through the 3S sheet 105, the prism sheet 109, and the 1/2-wave film 111 again by the operation which degree of polarization creased while repeating total reflection in the light guide plate 103, although not shown all over drawing, the light ich carried out total reflection turned into unpolarized-light light like the light which carried out outgoing radiation om the fluorescence pipe, and was described above, some optical components are used as an effective lighting light 2.

)21] Incidence of the light which penetrated the light guide plate 103 is carried out to the 1/4-wave film 113 which is ; 2nd polarization sensing element prepared in the lower part of a light guide plate 103. The 1/4-wave film 113 ·anges a phase leading shaft in the 45-degree direction to the oscillating direction of S wave 108 reflected in the PBS ;et 105. Although the linearly polarized light which carried out incidence to the 1/4-wave film 113 is changed into ; circular polarization of light by this arrangement, it is reflected by the reflecting plate 114 of a 1/4-wave film ·ther prepared in the lower part by sticking, and in case the 1/4-wave film 113 is penetrated again, it becomes the mponent which intersects perpendicularly to the oscillating direction of the polarization which carried out incidence, d outgoing radiation will be carried out. Since the oscillating direction of this polarization is equivalent to the mary wave which can be penetrated at the time of the incidence to the PBS sheet 105, incidence of it will be carried t to a liquid crystal panel as an effective lighting light 112.

)22] Thus, it is conventionally absorbed with the incidence side polarizing plate of a liquid crystal panel, and since ; optical component which was not used as a lighting light can be used as an effective lighting light, without being sorbed by the incidence side polarizing plate by composition of this example, the bright lighting system for liquid /stal panels which improved is realizable.

)23] In this example described above, although 1/2 and the 1/4-wave film which are a polarization sensing element ı be set as the arbitrary wavelength positions of a visible region as main wavelength, it is good to be set as the green ıvelength field where relative luminous efficiency is desirable the highest. Furthermore, among these phase contrast ms, the 1/2-wave film 111 is stuck to the incidence side polarizing plate of a liquid crystal panel, a 1/4-wave film ıck to a reflecting plate 114, respectively, and it is desirable that you are made to rival. Mirror planes, such as ıminum vacuum evaporationo side where a reflection factor is high, are sufficient as a reflecting plate 114, and in ler to give diffusibility to some extent, it may use the white board which performed gloss processing.

)24] Moreover, in order to prevent generating of moire, as for the pitch of a PBS sheet and a prism sheet, it is sirable to consider as the conditions from which it completely considers as the same pitch, or a pitch is made finely coarse, and a pitch differs remarkably so that moire may not be produced to the pixel array period of a liquid crystal nel, to consider a pitch as a random array, or to prepare an opening between a prism sheet and a liquid crystal panel. rthermore, it is also possible to insert a diffusion board with the diffuse-transmission effect combining one sheet or o or more sheets, and an insertion part between the upper surface of the prism sheet 109 or the prism sheet 109, and ; PBS sheet 105, between the prism sheet 105 and a light guide plate 103, or between a light guide plate 103 and the 4-wave film 113 for the purpose of prevention of rationalization of a lighting distribution and moire generating.

)25] The relation between optical arrangement of each optic of the display mentioned above and the oscillating :ection of light and its operation are shown in drawing 2 . Since the light source light which repeated total reflection thin the light guide plate 103 is unpolarized-light light (inside N of drawing), it has almost equally the component of th P component (the inside P of drawing, and display) which intersects perpendicularly mutually, and S component ıe inside S of drawing, and display). If this light carries out incidence to the PBS sheet 203, a primary wave will netrate and an S wave will be reflected. Although the transmitted primary wave penetrates the 1/2-wave film 204, ıce the phase leading shaft (the inside F of drawing and display) of a wavelength film serves as the direction of 22.5 gree to the direction of P, the angle of rotation of a primary wave becomes phase leading shaft orientations with 45 grees (1/root2 (P+S) and display). Since it is in agreement with the transparency shaft (inside T of drawing) of the :idence side polarizing plate 205 of a liquid crystal panel, this direction is penetrated, without absorbing almost, mely, is used as a lighting light.

026] On the other hand, although incidence of the S component light reflected with the PBS sheet 203 is carried out the 1/4-wave film 202 prepared in the lower part of a light guide plate 103, since the phase leading shaft (the inside of drawing and display) of the 1/4-wave film 202 serves as a 45-degree direction to the direction of S, the transmitted ;ht turns into the circular polarization of light (the inside C of drawing, and display). When it is reflected by the flecting plate 201 since the hand of cut becomes a retrose by reflection by the reflecting plate 201, and this circular ·larization of light penetrates the 1/4-wave film 202 again, the oscillating direction turns into the direction of P. ıerefore, since this optical component turns into the primary wave and this component which carry out incidence to ; direct PBS sheet 203 and which are penetrated, S polarization component absorbed conventionally will be fectively used as a lighting light.

027] Drawing 3 is drawing explaining the composition of the display concerning the 2nd example of this invention. is example removes the 1/4-wave film 202 which is the 2nd polarization sensing element prepared in the upper part a reflecting plate 201 among the composition in the 1st example explained previously, and has the PBS sheet 109 d structure which put the diffusion sheet 301 between light guide plates 103.

028] After diffusing suitably the unpolarized-light light (inside N of drawing) 302 which carried out outgoing diation of the light guide plate 103 so that the illumination distribution of a screen-display field may be optimized th the diffusion sheet 301, incidence of it is carried out to the PBS sheet 105. Like [component / primary-wave / ich penetrates the multilayer side 106 of a PBS sheet] the 1st example, rotation of condensing by the prism sheet 9 and the light guide by the 1/2-wave film 111 is received, and incidence is carried out to a liquid crystal panel as an fective lighting light.

029] Although incidence of the reflected S wave component 303 is again carried out to the diffusion sheet 301, nsparency or in case it is reflected slightly, unpolarized-light light is formed by the spreading effect with a diffusion eet (the inside N of drawing, 304). Therefore, since S polarization component 303 reflected by the PBS sheet 106 is anged into the unpolarized light 304 which the primary wave and the S wave mixed, when it is reflected by the lower rt or the reflecting plate 114 of a light guide plate 103 and incidence is again carried out to the PBS sheet 106, the imary-wave component 305 contained in the incident light will be penetrated alternatively, and will be effectively ed as a lighting light 306. Also in this example, it is possible like an example 1 to take various kinds of composition, ch as a pitch of the conditions of a phase contrast film, the property of a reflecting plate, a PBS sheet, and a prism eet and existence of introduction of a diffusion board.

030] Drawing 4 is drawing explaining the composition of the display concerning the 3rd example of this invention. the 1st example described, the polarizing plate transparency shaft of a liquid crystal panel is arranged in the ection of 45 degree to the side of a liquid crystal display field, as shown in drawing 4 (a) from the request of ewing-angle reservation. All over drawing, the solid line arrow showed the transparency shaft of a dotted line and an tgoing radiation side polarizing plate for the transparency shaft of an incidence side polarizing plate. For this reason, the 1st and the 2nd example, as shown in drawing 4 (b), when the formation direction 106 of the multilayer side of a S sheet is made into the direction of the side of a screen-display field, 45 degrees of transparency P polarization ht are rotated with the 1/2-wave film, so that it may be in agreement with the transparency shaft of an incidence side larizing plate.

031] On the other hand, in this example, as shown in drawing 4 (c), the formation direction 106 of the multilayer side a PBS sheet has been arranged in the 45-degree direction to the direction of the side of a screen-display field. By ing such structure, since polarization conversion is not received but ** is also in agreement with the transparency aft orientations of a polarizing plate with a 1/2-wave film, the primary wave which penetrated the PBS sheet comes possible [omitting the 1/2 wave film in the 1st and the 2nd example], and can reduce cost by it. Moreover, gradation of the white balance produced by the wavelength dispersion of a polarization sensing element is also lost. rthermore, since the direction of a PBS sheet turns into the direction of 45 degree also to the pixel array direction of iquid crystal panel, generating of the moire produced according to the interference effect of two periodic structural quences serves as a high frequency component which is hard to be checked by looking, and the effect which ppresses display image degradation is also acquired.

032] Drawing 5 is drawing explaining the composition of the display concerning the 4th example of this invention. this example, a multilayer reflective film is given to the prism interface 501 of the prism sheet 109, and it is aracterized by giving the prism sheet 109 in accordance with the condensing operation which is an original function, d the function of a polarization separation element like the PBS sheet in the 1st and the 2nd example.

033] Incidence of the unpolarized-light light 502 which carried out outgoing radiation of the light guide plate is rried out to the prism sheet 109, a primary wave 503 penetrates according to the interference effect with a multilayer, d non-wanted S wave 504 is reflected. Outgoing radiation of the transmitted primary wave 503 is carried out in the timal direction by condensing operation of prism as a lighting light, and it is changed in the polarization direction for ich it asks with the 1/2 more wave film 111. Re-incidence of reflected S wave 504 is carried out to a light guide te 103 by two reflection in respect of a multilayer. Henceforth, like the 1st example, it is changed into P polarization ht 505 by the 1/4-wave film 113 and the reflecting plate 114, the prism sheet 109 is penetrated, and it is used as a hting light.

034] Thus, thin display can be realized, without according to this example, not making the number of parts increase giving polarization segregation to a prism sheet, and making the thickness of display increase. In addition, it cannot overemphasized that it is possible to remove the 1/4-wave film 113 combining the 2nd example also in this ample, and to add the diffusion board 201.

035] Drawing 6 is drawing explaining the composition of the display concerning the 5th example of this invention. this example, the PBS pillar-shaped object 601 is arranged between the optical paths which carry out incidence to a ht guide plate 103 from the fluorescence pipe 101. The reflecting mirror 603 is formed in the undersurface of the S pillar-shaped object 601 of aluminum vacuum evaporationo etc., and the 1/4-wave film 604 is arranged at the orescence tubeside which is optical plane of incidence. The composition of a liquid crystal panel lighting field nsists of the lower shell reflecting plate 114, the light guide plate 103, a prism sheet 109, and a 1/2-wave film 111.

036] Although the 1/4-wave film 604 is penetrated, since it is unpolarized-light light, the unpolarized-light light 605 ich carried out outgoing radiation from the fluorescence pipe 101 does not receive a polarization conversion eration. In the multilayer interference side 602, a primary wave 606 penetrates the light which carried out incidence the PBS pillar-shaped object 601, and carries out incidence to a light guide plate 103. S wave 607 is reflected. The nsmitted primary wave 606 receives the total reflection in a light guide plate 103, condensing with the prism sheet 9, and polarization rotation with the 1/2-wave film 111, and is used as a lighting light. Since the reflection between parts within these parts is specular reflection mostly, P polarization light is effectively used with polarization light, thout reducing most of the degree of polarization.

)37] On the other hand, it is reflected by the mirror plane 603, and is again reflected in respect of [602] multilayer erference, and outgoing radiation of reflected S wave 607 is carried out to a fluorescence tubeside. Under the present cumstances, it will be used as a lighting light like the primary wave 606 which penetrated PBS601 this time since it s changed into a primary wave 609 in case it is reflected by the tubular surface of the fluorescence pipe 101, and the lector 102 although the 1/4-wave film 604 is changed from the linearly polarized light of S component to the cular polarization of light at the time of passage, and the 1/4-wave film 604 is penetrated again, and carried out idence to the light guide plate 103 and which carried out incidence to the direct light guide plate. Therefore, it is ssible to raise efficiency for light utilization with the composition in this example.

)38] Moreover, it is also possible to take the composition which combined this example and the 1-4th examples. ıder the present circumstances, it cannot be overemphasized that it is necessary to make it become the arrangement which the transmitted light polarization component of the polarization component which carries out outgoing liation from the PBS pillar-shaped object 601, a PBS sheet, or a prism sheet with polarization isolation corresponds.

)39] Drawing 7 (a) is drawing having shown the composition of the display concerning the 6th example of this vention. In addition to the composition of the 5th example in drawing 6 , composition in this example is aracterized by pinching the 1/2-wave film 701 between the PBS pillar-shaped object 601 and a light guide plate 103. case incidence of the primary wave 609 which carried out outgoing radiation of the PBS pillar-shaped object 601 is ried out to a light guide plate 103, it is changed into S wave 702 by the 1/2-wave film 701 with which the phase ding shaft became the direction of 45 degree to the primary wave 609. Moreover, similarly, if the linearly polarized ht of the direction of 2theta which contained both the components of a primary wave and an S wave when taking the ase leading shaft in the direction of theta, although illustration was not carried out inserts a 1/4-wave film instead, iptically polarized light or the circular polarization of light will be acquired.

)40] Thus, the polarization state of the light which can be made to carry out incidence of the light which had bitrary polarization components between the PBS pillar-shaped object 601 and the light guide plate 103 by inserting 1/2-wave film or 1/4-wave film which is a polarization sensing element into a light guide plate, and carries out idence to the prism sheet 109 can be designed and optimized freely.

)41] Moreover, since this example must make the polarization direction which carries out incidence to a light guide ite intersect perpendicularly mutually as shown in drawing 7 (b) when a fluorescence pipe is formed in each of the ection of a long side of a screen-display field, and the direction of a shorter side, or when a L character type orescence pipe is used, it is necessary to make one side into the 5th example [in / this example or drawing 6 / the S pillar-shaped object 601, and]. / this example in which polarization conversion after outgoing radiation

)42] Drawing 8 is drawing having shown the composition of the display concerning the 7th example of this vention. This example is characterized by changing the position of the 1/4-wave film 604 between PBS601 and a lector 102 into the front face of the fluorescence pipe 101 and a reflector 102 to the 5th example shown in drawing taking such arrangement -- the 5th example -- said -- the effect which is 1 is not only acquired, but since the 1/4-ve film 604 has stuck to the reflector, in case light passes along the inside of the 1/4-wave film 604 twice at the time incidence and reflection, a transparency field serves as the almost same portion Therefore, it is possible to raise a larization conversion efficiency by optimizing the property of the 1/4-wave film 604 for every each part grade.

)43] Drawing 9 is drawing having shown the composition of the display concerning the 8th example of this vention. As this example was shown in drawing as compared with the 5th example in drawing 6 , the 2nd page of the ıltilayer interference side 602 of PBS601 was established. The number of times of reflection of S wave 607 which it reflected in comparison with the 5th example, and carries out re-incidence to a fluorescence tubeside by considering this composition can be reduced once, and it becomes possible to suppress the optical strength reduction at the time reflection.

)44] Drawing 10 (a) and (b) are drawings showing the composition of the display concerning the 9th example of this vention. In this example, the light guide control object 1001 which controls the degree distribution of incident angle light which carries out incidence to a light guide plate 103 between the optical paths which carry out incidence to a ht guide plate 103 from the fluorescence pipe 101 proper is arranged. This light guide control object 1001 possesses mirror plane 1004 in the multilayer interference side and the vertical section which have polarization isolation in

: optical outgoing radiation side 1003.

)45] It is the example for which drawing 10 (a) used the convex type light guide control object, and drawing 10 (b) ed the concave light guide control object. The light guide control object 1001 has the function which controls the gree distribution 1002 of incident angle at the time of carrying out incidence of the light from the light source to a ht guide plate 103 to the proper angular distribution which total reflection produces, as shown in drawing 11 (a) and). The degree distribution of incident angle is determined by the refractive index of the light guide control object 01, and the angle of the optical outgoing radiation side 1003.

)46] At this example, by establishing a multilayer interference side in the optical outgoing radiation side 1003, after lecting in respect of [1004] a reflecting mirror, reflected S wave 607 is changed into a primary wave 606 by 2 nes transparency of the 1/4-wave film 604 like an example 5, and carries out incidence to a light guide plate. Here, ice a multilayer interference side does not contribute about control of the direction of optical outgoing radiation nich is the function of an original light guide control object, it is possible to make one light guide control object have ight guide control function and polarization isolation.

)47] Thus, it becomes possible to have a light guide control function and a polarization conversion function by cing the composition of this example, without causing increase-ization of a member or equipment compared with the nventional composition. Moreover, in this example, even if it inserts the position of the 1/4-wave film 604 between lectors 1004 from the position of drawing 10 (a) and (b), the same effect can be acquired. In this case, since the light nich carries out incidence to a reflector 1004 serves as oblique incidence from the multilayer interference side 1003, s necessary to optimize a retardation so that it may become a 1/4-wave film to these oblique incidence component ht.

)48] Drawing 12 (a) and (b) are drawings explaining the composition of the display concerning the 10th example of s invention. It is characterized by giving polarization isolation to the light guide control object 1001 of the method nich establishes an oblique incidence side in an optical incidence side, and controls the incident angle to a light guide ite by this example. In this example, the 1/4-wave film 604, the protective layer, and the multilayer interference side re formed in the oblique incidence side 1003 one by one from the light source side.

)49] Although the operation in this composition and its effect are the same as the 9th example, since the 1/4-wave m with a polarization conversion function is almost in contact with the multilayer interference side with polarization lation, it becomes possible to circular-polarization-of-light-ize the reflected S wave efficiently. Moreover, since near the distance reflected by the 1/4-wave film 604, the fluorescence pipe 101, and the reflector 102 can be carried out, : optical strength reduction by reflection can be suppressed.

050] It is possible to use it combining the 1st - the 4th example about the 10th composition of the 6th - an example of s invention described above as well as the 5th example. Drawing 13 is drawing explaining the composition of the splay concerning the 11th example of this invention. The feature of this example is characterized by establishing the oss-section serrated knife-like crevice 1201 in the lower part of a light guide plate 103. The principle of the larization separation in this example uses refraction in the interface in the angle expressed with brewster's-angle etaB =tan-1 (n2 / n1) (n2 : n1 : an incidence side medium refractive index, outgoing radiation side medium refractive lex), and reflection.

051] The light 1202 which carried out outgoing radiation of the fluorescence pipe 101 is unpolarized-light light, and cidence of it is carried out to a light guide plate 103, and it repeats total reflection. If this light carries out incidence to : crevice 1201 established in the lower part of a light guide plate 1202, since the incident angle to an interface will parate from a total reflection field, after it carries out outgoing radiation from a light guide plate 103 and an outgoing liation angle is controlled by the prism sheet 109 by the proper angle, the 1/2-wave film 111 is penetrated, and it comes lighting light. At this time, polarization separation can be performed by controlling the relation between the gle of a crevice, and the incident angle of light proper. Hereafter, this portion is explained in full detail.

052] Drawing 14 is drawing having expanded and shown the crevice 1201 established in the transparent material 103 d the lower part in drawing 13 . The case where the unpolarized-light light 1301 carries out incidence at an angle of oha to a light guide plate base is considered. If the degree of incident angle to the light reflex interface 1306 of a evice has accomplished thetaB at this time, although about 15% of an S wave component will be reflected, a imary-wave component is penetrated mostly altogether. Since the degree of incident angle to the up interface of a ht guide plate 103 serves as angle conditions used as total reflection, reflected S wave 1302 carries out outgoing diation of the light guide plate, and is used as a polarization lighting light.

053] On the other hand, although all about 85% of S wave components which penetrate the light reflex interface 06, and primary-wave components 1303 once carry out outgoing radiation of the light guide plate, after reflecting by rect or the reflecting plate 114, it will receive polarization selective reflection in an interface 1307 in reentry putting d the light reflex interface of an adjoining crevice, or will repeat total reflection on a light guide plate base or the ɔer surface. When becoming total reflection, the conversion for an S wave component from a primary-wave nponent arises suitably by repeating slanting reflection to the polarization direction. Moreover, when conversion of : polarization by reflection is not fully performed, lambda/2 film may be prepared in an interface 1307, and larization may be rotated, or unpolarized-light light may be formed as the weak diffusing surface. Thus, it becomes ssible by preparing the crevice of the optimal angle component for a light guide plate base to take out a high lighting ht of degree of polarization efficiently.

)54] When a polymethylmethacrylate (PMMA) is used as a light guide plate material and an optical outgoing liation side is made into air (refractive index 1.0) since a refractive index is about 1.5, the range of the degree alpha incident angle of the light 1301 which repeats total reflection is 0 degree < alpha< 48.2 degrees. Therefore, what is ɔessary is just to set desirably 14.3 degrees < theta< 56.3 degrees of angles theta which the interface 1306 of a ;vice and the light guide plate lower flat-surface section accomplish as a 26.3 degrees < theta< 36.3 degrees field, in ler for one component of the light in this range to accomplish the relation between an interface 1306 and brewster's-gle thetaB.

)55] Moreover, since a refractive index is set to about 1.6 when a polycarbonate (PC) is chosen as a light guide plate .terial, it is good to make 16.0 degrees < theta< 58.0 degrees into 28.0 degrees < theta< 38.0 degrees desirably from legree < alpha< 51.3 degrees conditions. It is possible to obtain the lighting light which has a uniform illuminance 1 degree of polarization over the whole lighting field surface by choosing a crevice including an optical outgoing liation side as this angle range, and optimizing the height of the crater of a crevice.

)56] In addition, this example can be applied, combining suitably either of the 1-4th examples, and either of the 5-th examples, combining either of the 1-4th examples, or either of the 5-10th examples.

)57]

ffect of the Invention] It is returned to a transparent material side, and unpolarized-light light is formed, without non-nted polarization light being absorbed by the polarization separation element while carrying out outgoing radiation the polarization light for which it asks among the light which carried out outgoing radiation from the emitter ɔording to [as explained above] this invention as a lighting light, or it is changed into a desired polarization nponent, and incidence is again carried out to a polarization separation element. For this reason, display with iciency for light utilization higher than before is realizable conventionally as a flat-surface type liquid crystal display ıich it is absorbed with the incidence side polarizing plate of a liquid crystal panel, and the optical component which .s not used as a lighting light is effectively used as a lighting light, therefore uses polarization light.

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nages caused by the us of this translation.

his document has been translated by computer. So the translation may not reflect the original precisely.
*** shows the word which can not be translated.
n the drawings, any words are not translated.

AWINGS

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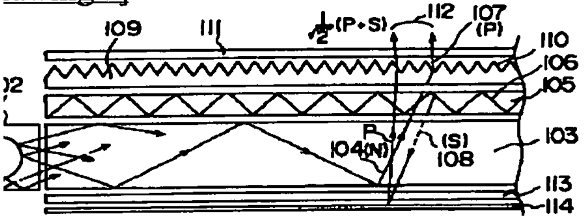
rawing 1]



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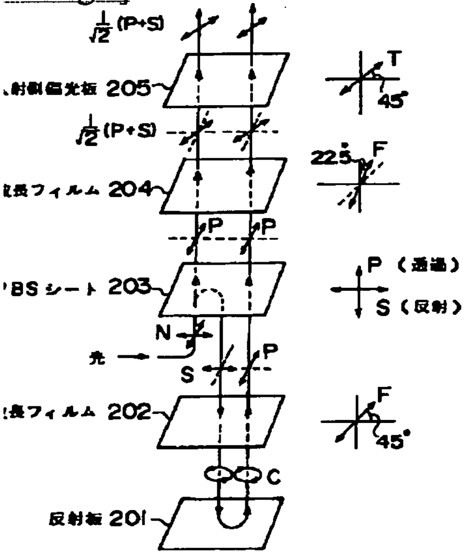

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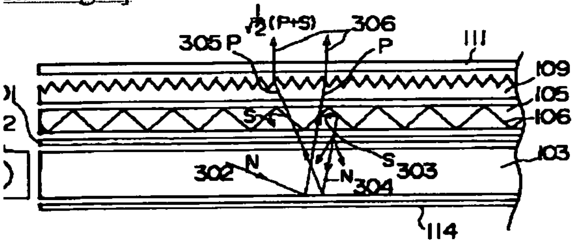

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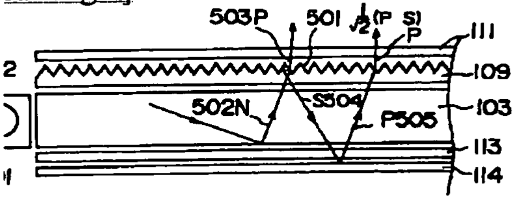

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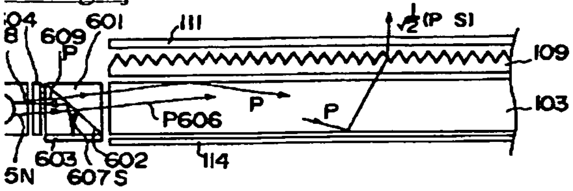

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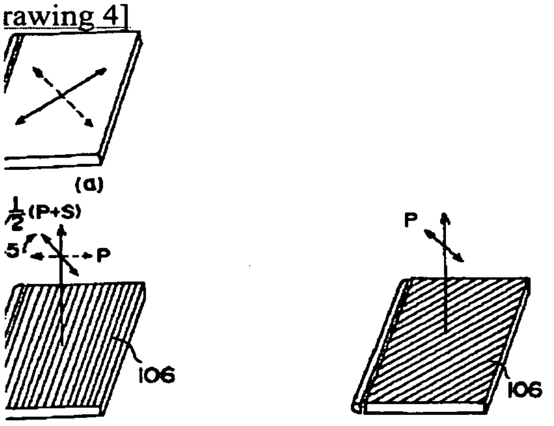
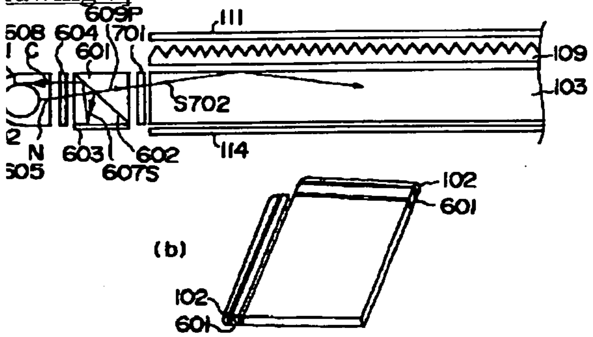


(a)

(b)

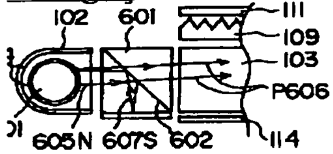
(c)

rawing 7]



(b)

rawing 8]



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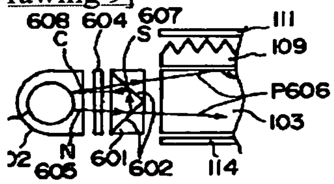

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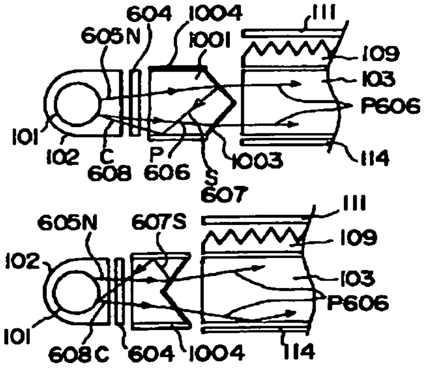

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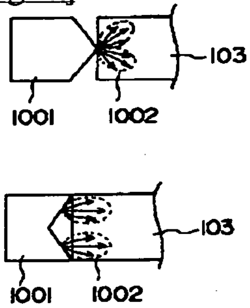

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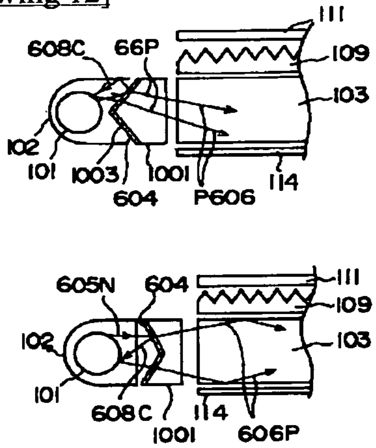

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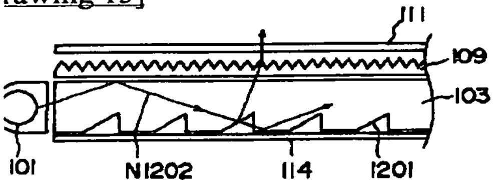

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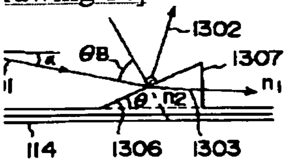

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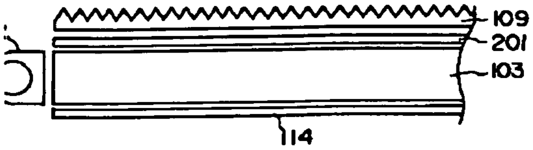

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mages caused by the use of this translation.

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**** shows the word which can not be translated.
n the drawings, any words are not translated.

)RRECTION or AMENDMENT

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fficial Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law.
ection partition] The 2nd partition of the 6th section.
ate of issue] January 26, Heisei 13 (2001. 1.26)

ıblication No.] JP,8-87011,A.
ate of Publication] April 2, Heisei 8 (1996. 4.2)
*** format] Open patent official report 8-871.
iling Number] Japanese Patent Application No. 6-222192.
he 7th edition of International Patent Classification]

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rocedure revision]
iling Date] July 5, Heisei 11 (1999. 7.5)
rocedure amendment 1]
ocument to be Amended] Specification.
em(s) to be Amended] Claim.
lethod of Amendment] Change.
roposed Amendment]
laim(s)]
laim 1] Emitter,
splay screen,
ıe polarization separation element which penetrates the 1st linearly polarized light component among the light from
e aforementioned emitter, and reflects the 2nd linearly polarized light component,
splay characterized by providing the reflective member which reflects the 2nd linearly polarized light component
flected with the aforementioned polarization separation element, and is returned to the aforementioned polarization
paration element.
laim 2] The aforementioned reflective member is display according to claim 1 characterized by changing the
orementioned 2nd linearly polarized light component into the aforementioned 1st linearly polarized light component.
laim 3] Display according to claim 1 characterized by the aforementioned display screen being a liquid crystal panel.

laim 4] Display according to claim 1 characterized by providing a polarization sensing element between the
orementioned display screen and the aforementioned polarization separation element.

aim 5] Emitter,
splay screen,
e polarization separation element which penetrates the 1st polarization component among the light from the
rementioned emitter, and reflects the 2nd polarization component,
posite arrangement is carried out at the aforementioned display screen, and the reflective member which has the
icavo-convex side which has an inclined plane in the incidence side of the light from the aforementioned emitter is
ovided.
e aforementioned inclined plane is display characterized by accomplishing the degree of tilt angle whose incident
gle of the light from an emitter is near the brewster's angle.

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